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Partners in Science

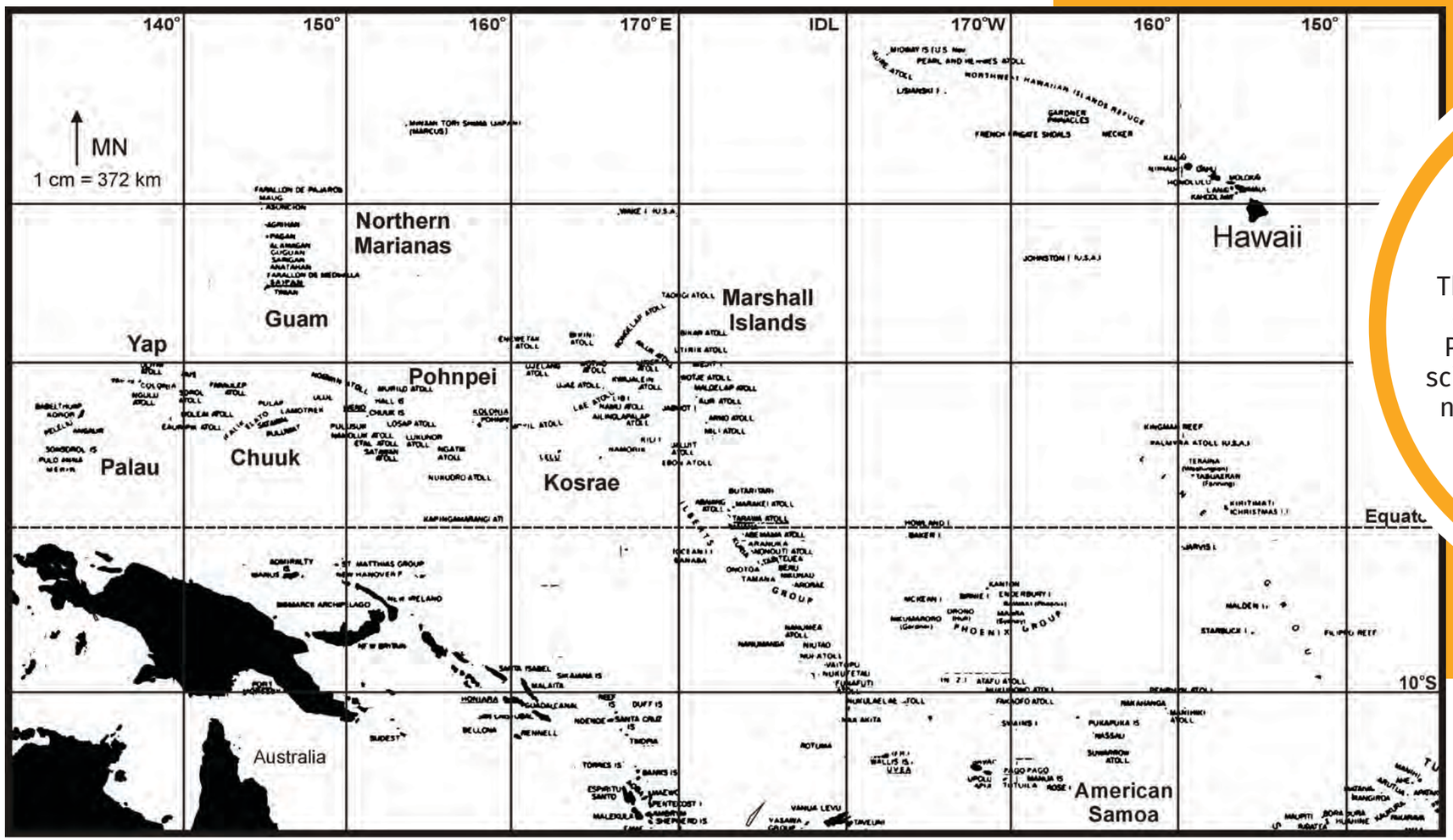
Institute of Pacific Islands Forestry and the U.S.-Affiliated Pacific Islands

Forest Service

Institute of Pacific Islands Forestry

The Institute of Pacific Islands Forestry is part of the USDA Forest Service's Pacific Southwest Research Station. The Institute has been a center of research and the application of science and technology throughout the Pacific Islands since 1967. The Institute's work supports the management, conservation, and restoration of natural forest and wetland ecosystems throughout the Pacific.

Areas of responsibility includes seven U.S.-affiliated political entities: the State of Hawai'i, the Territory of Guam, the Territory of American Samoa, the Commonwealth of the Northern Mariana Islands, the Republic of the Marshall Islands, the Federated States of Micronesia, and the Republic of Palau. While research and technological assistance focuses on Hawai'i and other Pacific Islands, results are applicable to many tropical and temperate ecosystems throughout the world.



Local Challenges, Global Implications

The Pacific region is a global hotspot of biological and cultural diversity, supporting endemic plant and animal species found nowhere else on earth. Native ecosystems provide benefits that are critical for human survival, such as clean drinking water, fisheries, food, fiber, and medicines. They also support unique cultural and social identities rich in tradition.

These rare landscapes, however, are threatened by changing climatic conditions, rising sea levels, non-sustainable land uses, and an influx of invasive species. Cultural and natural resources risk being degraded to the point of biological extinction/extirpation. Mitigating such eco-cultural threats requires creative management strategies, development and implementation of new solution-based tools, and coordination of their implementation across the Pacific region.

Mission

Through research, education, and demonstration, the Institute of Pacific Islands Forestry provides scientific and technical information needed to restore, conserve, and sustain tropical forests and wetlands of the Pacific.

Featured Partners

Thank you to our dedicated partners who work tirelessly to foster research and understanding to improve the lives and landscapes of the Pacific Islands.

WPN
Watershed
Professionals
Network

Message from the Director

The Institute of Pacific Islands Forestry is focused on the conservation and restoration needs of the Pacific region. As an organization, we've been dedicated to studying and understanding our Pacific Islands ecosystems since 1967.

We're committed to supporting the needs identified through the Statewide Assessment and Resource Strategy and codified in the 2010 Micronesia Challenge. Specific needs identified by these efforts include:

1. Decision support tools for more effective watershed management to protect water quality and quantity.
2. Updated geospatial data to allow for more accurate inventories of forested ecosystems and to identify coastal areas vulnerable to sea level rise.
3. Terrestrial, stream, and coastal wetland (e.g., mangrove) monitoring protocols to be implemented throughout the region.
4. Enhancement of urban forest resources and sustainability.
5. Tools for more effective control of invasive species.
6. Strategies to manage for native ecosystems that are resilient to invasion by exotic species and impacts of climate/landscape change.

We're meeting these needs through robust and fruitful partnerships. We're exchanging knowledge and providing training to assist communities develop and implement effective conservation and restoration projects and programs.

In this report, we highlight some of that work, while discussing future areas of research and additional projects to be implemented. We invite you to learn more about the efforts of our staff and incredible partners as we continue to learn, protect, and preserve the landscapes that make us who we are.

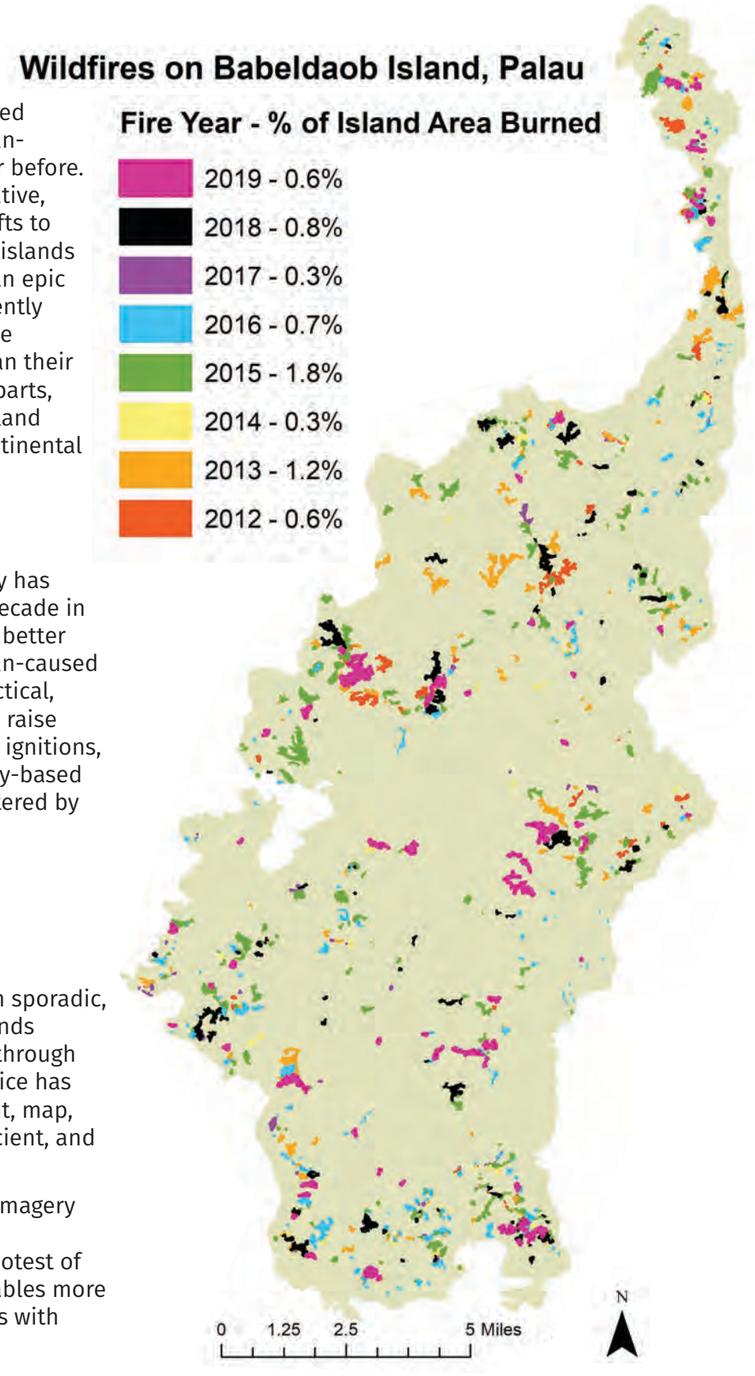
Susan Cordell, Ph.D.

Director

Strengthening Wildfire Awareness and Prevention in the Western Pacific

Background

Wildfire is a growing problem in the U.S.-affiliated Pacific Islands. Increased populations and an expanded road network are allowing more human-caused fires into more areas than ever before. Combine that with an influx of non-native, fire-prone vegetation and climatic shifts to warmer and drier conditions, and the islands — and their ecosystems — are facing an epic problem never encountered in its recently recorded history. While wildfires on the Pacific Islands might seem smaller than their attention-grabbing mainland counterparts, they burn a far greater percentage of land than anything experienced on the continental United States.



Priority Needs

The Institute of Pacific Islands Forestry has supported work throughout the last decade in the U.S.-affiliated Pacific Islands to (1) better track the occurrence and size of human-caused wildfires in the region,(2) develop practical, cost-effective prevention strategies to raise awareness and reduce human-caused ignitions, and (3) test and implement community-based strategies for restoring ecosystems altered by wildfire.

Approach

Fire Monitoring

Past efforts to monitor fires have been sporadic, making informative summaries on trends difficult. Since 2015, satellite imagery through the Digital Globe EV Web Hosting Service has made it possible to monitor, document, map, and quantify fires in a consistent, efficient, and affordable fashion year-round.

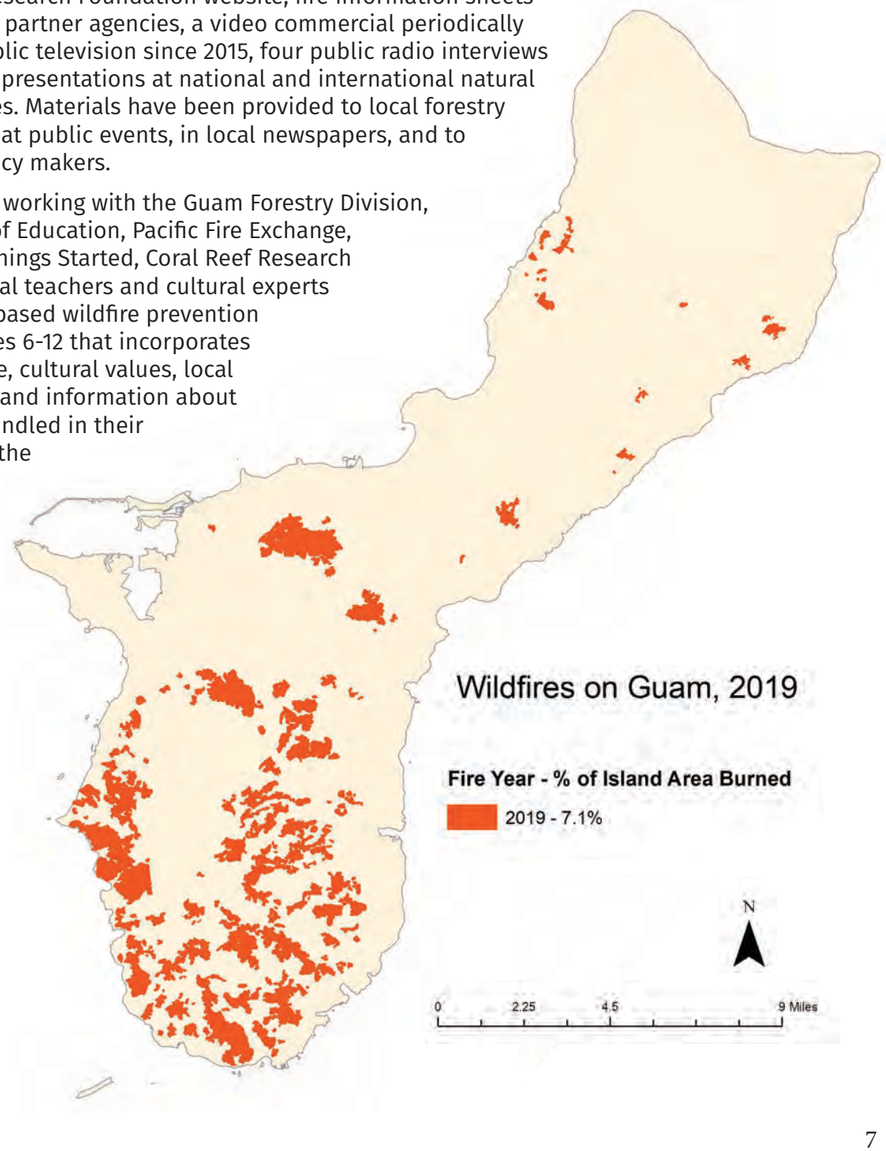
The consistency and precision of the imagery ensures accurate documentation and measurement of fires, even in the remotest of locations. Long-term fire mapping enables more accurate correlations of wildfire trends with weather patterns, helping improve public safety warnings and general land-use guidelines. Animated fire maps over time could also help the public visually understand the relationship of seasonal and periodic weather variations with wildfire occurrence.

Finally, long-term fire mapping can guide land management decisions that prioritize locations for fire breaks that can protect sensitive conservation areas, important watersheds, historical sites, residential neighborhoods, and valuable infrastructure.

Education and Awareness

The Institute of Pacific Islands Forestry has supported the production of various wildfire education and awareness products. These include roadside prevention messages made by Melekeok State elementary students, fire posters displayed in Koror State high schools, government buildings, and on the Coral Reef Research Foundation website, fire information sheets distributed to Palau partner agencies, a video commercial periodically played on Palau public television since 2015, four public radio interviews since 2012, and oral presentations at national and international natural resource conferences. Materials have been provided to local forestry offices for their use at public events, in local newspapers, and to provide to local policy makers.

The Institute is also working with the Guam Forestry Division, Guam Department of Education, Pacific Fire Exchange, Center for Getting Things Started, Coral Reef Research Foundation, and local teachers and cultural experts to develop a place-based wildfire prevention curriculum for grades 6-12 that incorporates indigenous language, cultural values, local fire maps and data, and information about how wildfires are handled in their communities. Once the Guam curriculum is developed, it will be modified to be more site-specific and culturally relevant to other islands throughout Micronesia.



Restoration and Shaded Fuel Breaks

Fire monitoring and mapping in Palau, Guam, and Yap have provided information used by managers to assess, design, and implement wildfire prevention measures known as shaded fuel breaks. Shaded fuel breaks are trees planted in strips with sparse vegetation between the strips to reduce the spread and intensity of wildfires. In Guam, fire maps and satellite imagery were used to document the initial failure of a shaded fuel break installed in 2016. Land managers took the information to modify the fuel break, which successfully stopped the advance of wildfires in 2017 and 2018.

Palau fire maps produced by the Institute in 2018 were used by Palau's Protected Area Network and Palau Forestry to strategically locate shaded fuel breaks in two protected areas. Fire maps have been used to justify vegetation treatment in Guam's wildland-urban interface areas in 2019. Based on three fire seasons, these maps have been used to identify the location of another shaded fuel break in the Cetti watershed of Guam in an area most likely not to burn.

In 2019, the Institute of Pacific Islands Forestry began working with the Ebiil Society to improve preventative measures and post-fire recovery within states having the highest wildfire rates in Palau. Ebill will develop restoration plans for burned areas, as well as identify locations for new shaded fire breaks to protect high priority forests and areas susceptible to recurring wildfires. Additionally, Ebiil will work with the communities of Ngardmau and Melekeok to integrate wildfire awareness and prevention into its education programs.

Outcomes

In the last decade, the collaborative work of the Institute of Pacific Islands Forestry and its partners has accomplished a great baseline in the three priority areas of fire monitoring, prevention and awareness education, and restoration and fuel break planning. This lays the groundwork to achieve the following future outcomes:

1. The publication of higher quality wildfire mapping products that will cover a greater geographic area. Improvements in automation will allow the maps to be produced and updated more quickly and affordably. The products will result in greater awareness of wildfire issues in the region, as well as improve understanding of when, where, and why fires occur.
2. The development of wildfire and hydrological models that integrate fire mapping and fire occurrence information, along with social and ecological factors. The information will allow land managers to better prioritize areas for restoration, wildfire prevention, and suppression.
3. The creation of cost-effective wildfire prevention programs that engage students through in-school programming and teacher training opportunities, as well as expand communities' wildfire prevention planning.
4. The growth of community-based restoration efforts across the region, with a focus on cost-effective prescriptions for establishing shaded fuel breaks in fire-impacted areas.

Reducing Erosion Through Wildfire Prevention, Post-fire Restoration

Background

Fire is a major ecological concern in tropical island communities: a non-native disturbance that causes losses of native biota, altered hydrological and ecosystem processes, and reduced ecosystem services.

For the country of Palau, these fires burn savanna vegetation, which in the process, expose soils and can lead to erosion. When rain falls on these exposed sites, sediment can be carried into streams and transported to nearshore reefs. The deposited sediment can threaten coral systems that support reef fish, of considerable economic importance in Palau, by stressing—or in the worst case—smothering corals.

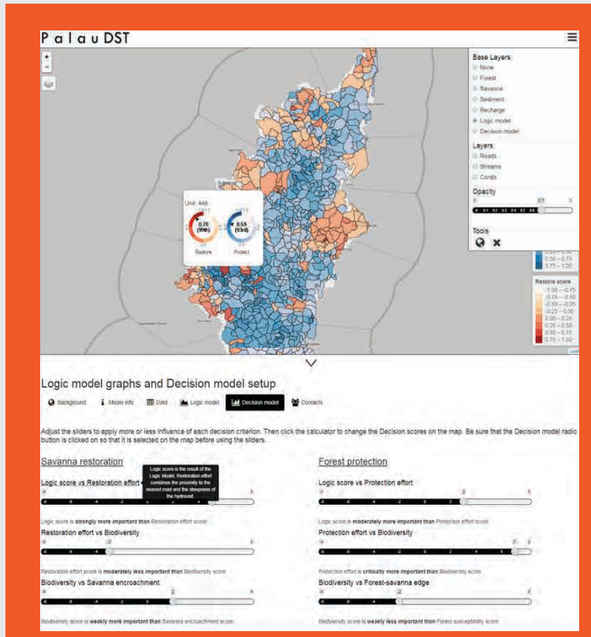
Priority Needs

Christian Giardina and Rich MacKenzie, researchers with the U.S. Forest Service's Institute of Pacific Island Forestry, Nick Povach, a researcher with the Forest Service's Pacific Southwest Research Station, and Paul Hessburg and Keith Reynolds of the Pacific Northwest Research Station developed a software-based decision support system capable of identifying watersheds that are particularly vulnerable to post-wildfire erosion. The research team took existing protocols successfully used in temperate environments and modified them for tropical conditions, specifically those found on Palau.

The resulting work is providing land managers with a map prioritizing which watersheds across Palau's main island of Babeldaob are in most need of protection from wildfire to prevent sediment inputs to nearshore areas, or would most need to be restored after a wildfire to minimize erosion. The decision support system factored in a landscape's slope, proximity to waterways, and likelihood of severe wildfire behavior. Outputs could be modified to show the area's proximity to restoration resources for land managers with limited time or budgets to access more remote areas.

Work Completed

The scientists tested their protocol on Babeldaob. The web-based interface allowed land managers to emphasize various decision-making factors or considerations over others, thereby generating results tailored to specific circumstances. Multiple scenarios were run with different criteria being "weighted" to allow land managers to better see their options and optimize their decision-making. The researchers have used their experience with Babeldaob Island to plan follow-up training for land managers on Palau, with the potential of this work being extended to other areas of Micronesia.



Conserving Palau Orchids

Background

Only a rudimentary understanding of orchids on Palau exists, despite the flowers' charismatic nature. The Institute of Pacific Islands Forestry is partnering with the Smithsonian Institution to change that.

Part of the Smithsonian's global orchid conservation initiative, researchers, partnering organizations, and volunteers are canvassing the archipelago to inventory orchid species, their associated habitats, as well as the underground mycorrhizal fungi essential to their survival. Once completed, land managers will have baseline data to track Orchidaceae persistence, as well as insights in how to conserve specific species should their numbers decline.

Priority Needs

A better understanding of Orchidaceae biology, ecology, and associated fungi is necessary to support conservation efforts. The pioneering work of the Institute, in collaboration with the Smithsonian, is establishing long-term monitoring sites, as well as creating a blueprint for other Pacific Islands to follow when inventorying their own orchids to germinate and grow.

IPIF

Work Completed

The Palau Orchid Conservation Initiative was formally created in 2016, with a postdoctoral researcher hired the following year to administer the initiative's objectives.

In 2018, the orchids and associated mycorrhizae were sampled in the Smithsonian's Forest Global Earth Observatory plot in Palau's Ngardok Nature Reserve. That same year, the first field guide of all the orchids within the nature reserve was developed.

The current inventory of Ngardok Nature Reserve orchids and mycorrhizae is particularly significant because of the diverse ecosystems with the reserve: denuded badlands, open savannas, young forests, mature forests, solitary trees, and isolated tree islands.

A three dimensional model (called an "orchid-gami") was designed, printed, and distributed in 2019 for a Palauan endemic orchid, Dipodium freycinetioides. The orchid-gami is now being used in orchid educational outreach across Palau and is available online at https://northamericanorchidcenter.org/wp-content/uploads/2019/06/PalauHyacinthOrchid_ printout.pdf.

Future Work Needed

Work will continue in isolating fungi associated with various orchid species of Palau. This type of work is critical for future orchid conservation, as associated fungi must be present for orchids to germinate and grow.

Planting Gardens of Breadfruit

Background

Breadfruit *(Artocarpus altilis)* is an important traditional staple for many indigenous communities across the Pacific, including the islands of Yap in the Federated States of Micronesia. In addition to food, its wood is used for building material, carvings, and for the construction of canoes. Super Typhoon Maysak directly hit the Outer Islands in March 2015, impacting 90% of crops and trees, including breadfruit, in both Chuuk and Yap. An extended drought in Yap that lasted through September 2016 negatively impacted crop recovery.

The Melai Mai Project was initiated in 2016 in response to Typhoon Maysak to enhance agroforestry resources and reduce food security risks for the islands through the importation of select breadfruit varieties. Each variety has its own characteristics and fruiting season. With an increase in the amount and diversity of breadfruit planted on the islands, it will extend the length of harvest to improve food production and overall food security.

Melai Mai translates to “planting gardens of breadfruit” in the language of the Outer Islands of Yap. The Melai Mai initiative reflects partnerships with communities, traditional leaders, local governments, research extensions, and the U.S. Forest Service to promote agroforestry, local food production, sustainability, and food security for local island communities.

Priority Needs

Through a partnership with the Yap State Division of Agriculture and Forestry, the Council of Tamol (the traditional council of chiefs for the Outer Islands of Yap), and local chiefs of the island communities, the Institute of Pacific Islands Forestry and the Forest Service’s State and Private Forestry branch worked to import and deliver breadfruit trees that had been screened and found free of disease (through a process called “tissue culturing”) and certified pest-free by the U.S. Department of Agriculture. The Republic of Palau’s Bureau of Agriculture and the Palau Community College – Cooperative Research Extension also requested assistance from the Institute of Pacific Islands Forestry to import one of the most productive and nutritious breadfruit varieties, known as Ma’afala, to improve Palau’s food security.

Work Completed

More than 450 tissue-cultured breadfruit trees were delivered to Yap Proper and 5 Outer Islands (Falalop Ulithi, Mogmog, Federai, Asor, and Fais) in 2017. Local nurseries were established in both Ulithi and Fais to grow the trees until they were ready for community distribution. An additional 800 trees were delivered in 2018 for communities across Yap Proper, Fais, and the atolls of Woleai, Ifaluk, and Ulithi. Meetings were held with the Council of Tamol, local village chiefs, and local communities to discuss the importance of local food production, preservation of existing breadfruit varieties, and how to care for the newly imported trees. Trees imported to Yap in 2017 were already bearing fruit in 2019.

More than 650 breadfruit trees were delivered to Palau in 2018, and by 2019, all were distributed across the 16 states of Palau, including the far Southwest Islands.

Staff from the Yap Division of Agriculture and Forestry, Palau Community College, and Palau Forestry participated in a week-long training in 2019, facilitated by the Institute of Pacific Islands Forestry, on breadfruit pruning, propagation, and commercial processing. A public workshop was held that same year to share information with Palau’s local farmers about breadfruit cultivation and harvesting learned on the Hawaiian Islands.

Melekeok State requested the Forest Service, Bureau of Agriculture, and Palau Community College to plant a community agroforest in Melekeok with the Ngaraioll Women’s Group. The governor of Melekeok negotiated a location for a community agroforestry garden, the first of its kind in the country. Imported breadfruit trees were a part of this planting, in addition to plantings of other fruit trees, timber trees, and medicinal plants.

Future Work Needed

Work to document existing breadfruit varieties and indigenous knowledge associated with each variety in Yap has been requested by the Yap Division of Agriculture and Forestry. Variety documentation can be coupled with genetics work to confirm distinct varieties. Palau officials have also requested assistance in documenting existing local varieties of breadfruit and maintaining a germplasm of Palauan varieties for future propagation.

Mitigating Climate Effects with Mangroves

Background

Intact mangrove forests provide food, fiber, and fuel for indigenous peoples across the Asia Pacific region. Mangrove trees also protect coastlines from powerful waves generated by storms, as well as remove and store massive amounts of atmospheric carbon dioxide, potentially mitigating impacts of climate change. As Pacific Islands face the threat of rising sea levels, mangroves might provide yet another unexpected benefit: the ability to maintain the elevation of an island's coastline at a rate that keeps up with or outpaces sea level changes.

Priority Needs

Micronesian mangroves are the most intact and productive mangroves in the world. Conservation of these ecosystems is essential for the continual provision of their many ecological benefits. Monitoring mangroves is a vital part of their conservation.

Information gathered through monitoring can be used to: 1) identify characteristics of mangroves keeping up with sea level rise, 2) develop restoration strategies for mangroves not keeping up with sea level changes, and 3) monitor the effectiveness of the Micronesia Challenge, a regional effort where Micronesian countries set aside 20% of their terrestrial resources (including mangroves) for conservation.

Work Completed

Working with Pohnpei Forestry and the Kosrae Island Resource Management Authority (KIRMA), the Institute of Pacific Islands Forestry finished installing rod surface elevation tables (rSETs) in three distinct geomorphological locations within the mangroves: interior, fringe, and riverine. rSETs measure changes in forest floor elevation over time relative to a fixed substratum. Changes in forest floor elevation can also be measured over time by attaching a terrestrial compact biomass LiDAR system that can rapidly scan 30,000 different points of the forest floor within the plot.

Researchers with the Institute of Pacific Islands Forestry remeasured a sub-set of monitoring sites within Pohnpei mangrove forests using both the compact biomass LiDAR system and the new rSETs. Both methods revealed that the mangrove plots measured had risen about 6 mm since 2017. In comparison, sea level rise within the same time period was 3.8 mm/year. The accuracy of the compact biomass LiDAR system was much higher and captured a greater range in elevation change (-6.6 to 18.3 mm) compared to rSET (3.4 to 7.7 mm). This was likely influenced by lower human error associated with the compact biomass LiDAR system compared to rSETs. Human error with rSETs can occur when rSET readers change from year to year as well as with the replacement of pins used to determine the forest floor surface. Institute of Pacific Islands Forestry researchers, therefore, suggest that this new method represents a significant improvement over the manual surface elevation table method. Results also suggest that mangrove forests can effectively trap inland sediment before it's washed out to sea, allowing for the accumulation of soil and build-up of the coastline.

Work in progress

Pohnpei Forestry and KIRMA will continue to read the newly installed rod surface elevation tables and analyze data. Working with the U.S. Geological Survey, Institute of Pacific Islands Forestry researchers have nearly finished assessing mangroves on Pohnpei for their vulnerability to changing climatic conditions using the WARMER model. The model predicts how/where mangroves will likely migrate, as well as how the composition of island vegetation may shift, in response to predicted climate changes and resultant sea level changes.

The data will help land managers determine which parts of the island will be able to adequately support mangroves and which areas might require more active management. how species distributions will shift, and ultimately identify mangroves that may be more resilient to rising sea levels. Similar assessments are underway in Kosrae.

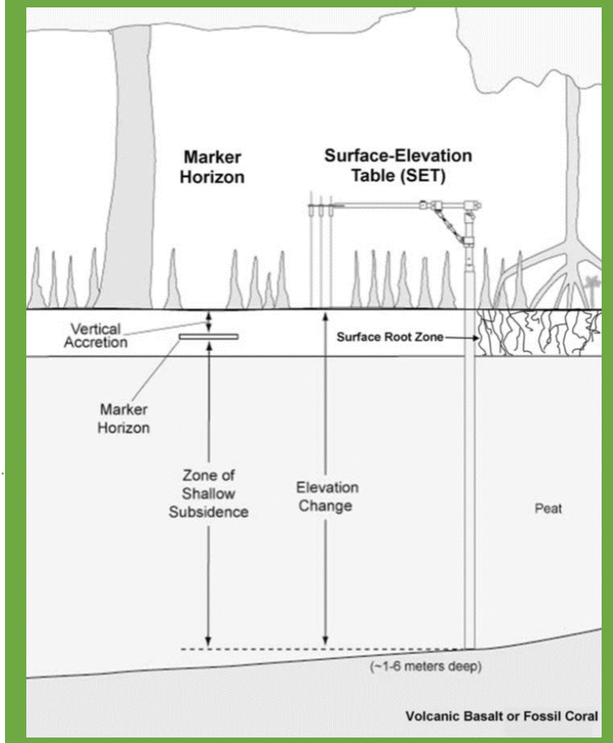
The Institute of Pacific Islands Forestry also is working with KIRMA to hold workshops to engage the local communities on the importance of mangrove conservation, the work that we are doing, and identify areas that are important to the communities.

Future Work Needed

Funding from the U.S. Agency for International Development, the U.S. Geological Survey, and the U.S. Forest Service will support several needs in the Federated States of Micronesia. First, we will work with the Micronesia Conservation Trust and Pohnpei Forestry to install rod surface elevation tables on the western side of Pohnpei. Institute of Pacific Islands Forestry researchers will also deploy salinity and water level monitoring devices to track seasonal and annual changes in mean sea level around the island. Data will also be used in the WARMER model.

Second, we will work with KIRMA to collect elevation points in mangroves around Kosrae to build a digital elevation model needed in the WARMER model. Third, we will start to establish mangrove forest plots and rSETs on Yap to help in the monitoring of their Micronesia Challenge mangrove plots.

If there is enough funding, we will also travel to Palau. Melekeok has requested assistance to create a sediment monitoring program for Ngardok Lake. This information is not only important for preserving this important heritage site, but can also be used to monitor impacts to mangrove forests downstream. Lastly, we will travel to Madagascar as part of a project funded by the Partnerships for Enhanced Engagement in Research, "Mangrove Forest Carbon and Socioeconomic Data to Improve Management in Madagascar." This project will establish 32 plots in forested areas and 32 plots in deforested areas and will quantify forest carbon stocks, forest structure, and carbon burial rates. This data will be tied to social and economic data that will also be collected from the same mangroves to develop more effective community-based management strategies.



Controlling Erosion with Locally Made Devices

Background

Erosion on Pacific Islands not only removes valuable soil needed to support vegetation, but it can also deposit sediment in nearshore areas, rivers, and lakes, negatively impacting coral reefs and local water quality. On Palau, minimizing erosion and sediment deposition has become a conservation priority for local communities and land managers. Land managers are working with researchers from the Institute of Pacific Islands Forestry to identify areas on the island prone to erosion, and then develop low cost methods that use local materials to prevent it.

Priority Needs

The Melekeok Conservation Network of Melekeok State contains both a terrestrial and marine protected area, the Ngardok Nature Reserve and the Ngermedellim Marine Sanctuary. Lake Ngardok, the largest freshwater body in Micronesia, lies within the Ngardok Nature Reserve and is the primary source of drinking water for Melekeok State. Minimizing sediment runoff and deposition into the lake and the Ngermedellim Marine Sanctuary is a priority to protect both drinking water and valued marine resources.

Running computerized simulations using hydrological models developed by U.S. Forest Service researchers on the mainland (the Babeldaob Decision Support Tool), Institute of Pacific Islands Forestry researchers determined that Melekeok State would be a hotspot for erosion if bare soil were exposed or vegetation removed. A particular area of concern was the sparsely vegetated, degraded savannas within the Ngardok Nature Reserve.

Work Completed

Melekeok Conservation Network staff and Institute of Pacific Islands Forestry researchers worked with local community members to determine that a series of woven baskets from coconut leaves could be interconnected to potentially stem the flow of sediment. The baskets were filled with coconut husks discarded from local coconut oil producers, and then secured to the ground with “living stakes” – stakes that also serve as cuttings made from native vegetation that will sprout and grow.

Overlapping layers of baskets were secured along several demonstration areas prone to erosion in the Ngardok Nature Reserve in 2020. Just above and below the baskets, several rows of native plants and trees were planted that would not only slow the speed of erosive water, but also take advantage of whatever sediment was deposited from the network of baskets. The live vegetation would also assist in sediment capture and aid in the filtration of water through their roots and soil. Sediment rods were installed just above each erosion control device to determine the efficacy of the traps and measure of sediment captured by the devices.

Future Work Needed

Staff from the Melekeok Conservation Network will monitor the rods and measure sediment collected monthly for six months. If the erosion control devices are found to be effective, a more rigorous research project will be established to document sediment movement. Project sites will serve as a model to be used in other areas that would benefit from erosion control, particularly within Palau’s Protected Area Network.

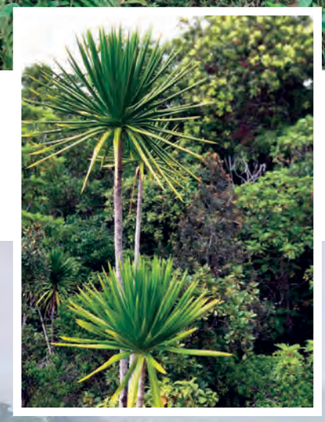
Monitoring the Present to Conserve the Future

IPIF

Background

The Palauan Island of Babeldaob contains the largest intact native tropical lowland rainforest in the Pacific, representing one of the most diverse forests in Micronesia. In 2018, the Ngardok Nature Reserve on Babeldaob became part of the Smithsonian Institution's Forest Global Earth Observatory (ForestGEO), a global network of sites monitored by the Smithsonian and its partners to track long term changes to unique ecosystems resulting from human and environmental factors.

Researchers with the Institute of Pacific Islands Forestry are working with the Palauan government and its partners to develop and implement monitoring protocols that meet the needs of the ForestGEO network, as well as fulfill monitoring requirements set forth by the Micronesia Challenge, a region-wide initiative encouraging Pacific Islands to commit a percentage of their land bases for conservation purposes (30% nearshore marine environments and 20% terrestrial resources) by 2020.



Priority Needs

The ForestGEO monitoring protocols were set forth by the Smithsonian's Center for Tropical Forest Science. It requires high-resolution measurements providing detailed information about the growth, survivorship, and mortality of individual plants within a designated area. The information will provide a baseline to compare changes in species composition, growth rates, and death that could result from changing climatic conditions, such as warmer temperatures or reduced precipitation. Information collected for the Smithsonian could also be repurposed to meet terrestrial monitoring objectives of the Micronesia Challenge.

Work Completed

About 10 acres of the Ngardok Nature Reserve have been established as a permanent monitoring site as of 2018. The Institute of Pacific Islands Forestry has trained six conservation professionals from Palau to monitor the site. Botanical work within the permanent plot has directly led to the revision of the plant genus of *Osmoxylon* (Araliaceae) in Palau in 2016. It also resulted in the identification of a new tree species, *Osmoxylon ngardokense*.

Future Work Needed

Researchers and conservation professionals have inventoried more than 14,000 trees within the Ngardok monitoring site. Full inventories of the monitoring site will be conducted every four to five years. Meanwhile, a weather station that was established for the site in 2015 will collect climate and weather data into perpetuity.

In addition to the data collection protocols established by the Smithsonian's Center for Tropical Forest Science, researchers and conservation specialists are working with a post-doctoral orchid specialist to develop a methodology for inventorying and monitoring orchids and their associated fungi within the Ngardok plot. The orchid specialist was hired in 2017 through an interagency agreement with the Smithsonian Institution and the Institute of Pacific Islands Forestry.

The methodology developed in Palau has the potential to be adopted across all ForestGEO sites using Center for Tropical Forest Science monitoring protocols. It would represent the first broad scale, standardized monitoring of tropical epiphytic orchids.

Characterizing Carbon Sources through eDNA

Background

Mangroves create rich habitats for a diversity of species while linking terrestrial and marine ecosystems. Conserving mangroves is a major concern of Pacific Islanders who depend on these ecosystems for maintaining sustenance and protecting coastal areas from typhoons and other disturbances exacerbated by rising sea levels. Mangroves are also important for reducing greenhouse gases globally, as they can store carbon for thousands of years, both within their roots and tissue, as well as within the sediment they trap.

Priority Needs

As Pacific Island ecosystems become altered from pollution, the introduction of invasive species, and changing climatic condition, scientists are raising concerns that these shifts could impact the structure and chemical composition of the sediment mangroves so heavily rely upon. Researchers with the Institute of Pacific Islands Forestry are spearheading an effort in Pohnpei to inventory and analyze any changes to mangrove sediment. The researchers are using trace amounts of plant and animal DNA found within the sediment to help characterize its composition, as well as identify the origins of the sediment.

It is hoped this novel approach of using environmental DNA can help land managers identify species and locations particularly important to the nutrient cycling and accumulation of sediment necessary for mangrove flourishing.

The efforts of Institute of Pacific Islands Forestry researchers and their partners aim to answer questions such as: 1) to what degree can eDNA approaches characterize the identity and origin of organic carbon in mangrove sediment; 2) what is the relative contribution of organic carbon from plants and animals across phyla in mangrove sediments; 3) how do accumulation and preservation rates vary with the community composition and origin of organic carbon in mangrove sediments, and 4) how does microbial community composition in sediments vary with respect to primary productivity in mangroves.

Work in Progress

An exploratory study in Pohnpei's mangroves was initiated in 2019 to evaluate eDNA sampling and preservation strategies.

Future Work

Researchers anticipate expanding their sampling effort to mangrove systems on other islands in collaboration with ongoing mangrove monitoring projects. Leveraging previous and ongoing work on mangrove sedimentation is a key component to applying eDNA effectively with respect to determining the origin and flux of organic carbon in these systems.

Institute of Pacific Islands Forestry
Supported Publications in the Pacific 2010-2020

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Kauffman J.B.; Adame, M.F.; Arifanti, V.B.; Schile-Beers, L.M.; Bernardino, A.F.; Bhomia, R.K.; Donato, D.C.; Feller, I.; Ferreira, T.O.; Garcia, M.C.J.; MacKenzie, R.A.; Megonigal, J.P.; Murdiyarso, D.; Simpson, L.; Trejo. H.H. 2020. Total ecosystem carbon stocks of mangroves across broad global environmental and physical gradients. Ecological Monographs.

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